Seismic event impacts and human response
3.1.5.4 Hazards

What you need to know
The primary and secondary impacts of seismic hazards including environmental, social, economic, political.
Short and long-term responses; risk management designed to reduce the impacts of the hazard through preparedness, mitigation, prevention and adaptation.
Impacts and human responses as evidenced by a recent seismic event.

The primary impacts of seismic hazards

Earthquakes can be devastating. They shake and collapse buildings, trapping and killing people inside. In countries with building control and expensive aseismic (earthquake-resistant) building design, death tolls can be much lower than in countries where these measures are not in place. It is often said that 'earthquakes don't kill people, buildings do' and there is plenty of evidence to support this. The 2016 Kumamoto earthquakes (magnitude 7.0) killed 49 people in Japan, whereas the Haiti earthquake in 2010, of the same magnitude, killed approximately 220 000 people. Building collapse was the key reason for the deaths in Haiti, although lack of preparedness also had a part to play in the disaster. Earthquakes can also destroy communications and transport infrastructure, this can reduce access for emergency services and slow the movement of emergency aid to the worst hit areas. When water and gas pipes rupture, they can cause short-term problems for the emergency services, as water is not available to put out fires.

Why do more people die in some earthquakes than others?

Physical factors	Human factors
Location of epicentre: if the epicentre is near urban areas more buildings and people are going to be affected	Population density: there are likely to be more deaths and damage when earthquakes strike densely populated areas
Time of day: more deaths can occur if people are asleep/inside, especially when buildings are poorly built	Level of development: rich countries can afford to mitigate the impact of earthquakes through prediction, protection and preparation
Geology: unconsolidated rocks such as clay and sand can amplify shockwaves and cause the collapse of buildings	Prediction: forecasting when and where an earthquake might strike can provide planning time for people
Depth of focus: shallow-focused earthquakes cause more shaking	Building control and aseismic building designs can prevent building collapse and save lives

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The secondary impacts of seismic hazards

Longer-term impacts can sometimes be difficult to deal with. The speed of rebuilding is influenced by the wealth and resilience of the nation.

- **Social impacts.** Earthquakes can cause a huge amount of damage; this can affect people for months and years afterwards. Even if people are not killed in the earthquake itself, living without shelter, clean water and other necessities can be hazardous to health. Survivors of the 2016 Ecuador earthquake that killed 570 people had limited access to food and basic aid, especially those in remote locations. The country also struggled to deal with the disaster since its economy is dependant on falling oil revenues. Conditions were also harsh for survivors of the January 1995 Kobe earthquake. Some 300 000 people were made homeless and had to live through winter in temporary shelters. This caused many more deaths from pneumonia and bronchitis than usual. Living in areas where water pipes are broken and sewage treatment is inadequate can cause further health problems. After the Nepal earthquake in April 2015, damaged pipelines were unable to supply people in the Kathmandu valley with clean water. The demand for water was met by using spring and well water, however this was highly contaminated with E. coli and coliform bacteria and caused an escalation of diarrhoeal diseases, especially in children.

- **Economic impacts**. The economic impacts of an earthquake include the disruption to industry, loss of jobs and cost of rebuilding. The total cost of the 1995 Kobe earthquake in Japan was in excess of $220 billion. Some companies such as Kobe Steel Ltd and Panasonic had to close temporarily and many others shut completely; even if main plant was unaffected, component and assembly plant loss could halt production. After the Sendai earthquake in 2011, also in Japan, exports of new vehicles declined by 67 per cent and GDP declined by less than two per cent. In New Zealand the GDP reduced by 14 per cent after the 2011 Christchurch earthquake - more significant than the Sendai earthquake to Japan. This is perhaps an indicator of the economic importance of Christchurch; Sendai being proportionately less significant to the Japanese economy.

Short-term responses

The main short-term response to an earthquake involves search and rescue and given that 75 per cent of deaths during an earthquake are caused by asphyxiation or being hit/crushed by falling buildings, then the first 24 hours are critical. Teams of specialist medics, rescue teams including sniffer dogs and heavy-lifting equipment can help to extract the injured from the rubble and provide life-saving medical care, but only if they can get to the scene quickly. International charities such as Médecins Sans Frontières/Doctors Without Borders (MSF) work in over 60 countries around the world to provide this kind of emergency response. Within 15 minutes of the 2015 Nepal earthquake, Prime Minister Narendra Modi requested the dispatch of relief and rescue teams to the worst affected areas. Pakistan immediately sent a plane packed with a 30-bed hospital, 2,000 military meals, 600 blankets and 200 tents. India sent an army mountaineering team to recover the bodies of 19 mountaineers and rescue 61 stranded climbers from Mount Everest. In

the end over 60 countries and hundreds of charities helped with the initial emergency and humanitarian response in Nepal.

Strong earthquakes that struck Italy and Myanmar on 24 August 2016 had very different outcomes. Over 250 people died in the 6.2 magnitude quake that struck the old stone houses of the remote villages of Amatrice, Accumoli and Arquata del Trontoin in central Italy at 3.36 a.m local time. According to the US Geological Survey, most of the houses in the area (unreinforced brick or concrete frame buildings) were vulnerable to earthquakes and offered little resistance to the powerful ground movements. Most people were asleep in their beds when it struck. (This earthquake repeated scenes from Aquila - less than 50 km away - struck by a 6.3 magnitude earthquake in April 2009, killing 295.)

On the same day, the 6.8 magnitude earthquake that struck in Myanmar was stronger, but caused far less damage, even though Myanmar is a poorer country. At least 185 Buddhist pagodas and temples were damaged in the city of Bagan, but only four deaths were reported. Why the difference in death tolls? The Myanmar earthquake had a deeper focus, occurred in a forested area, the buildings in nearby cities stood firm and occurring at 5.04 p.m local time people were awake and had been warned by a strong foreshock that gave them time to evacuate buildings.

Long-term responses

The probability that an earthquake can strike can now be measured, but this does not help us to predict precisely when or where they might occur. The best way to be ready for an earthquake is to be **prepared**. Methods of mitigation can involve **protection** (educating people or improving building design) and **planning** (emergency evacuation plans, information management and warning systems).

Educating the public as to what to do in the event of an earthquake can include the advice by the Southern California Earthquake Centre to 'Drop, Cover and Hold on' (http://www.dropcoverholdon.org) or the Japanese advice for those near the coast to run to high ground to avoid incoming tsunami waves. For those living in earthquake zones, the best form of mitigation is hazard-resistant design. Buildings made of mud-brick (adobe) or natural materials tend to collapse, but may not kill people if the roof material is light. Poorly built multi-storey buildings are the most hazardous as the walls give way and floors collapse easily - known as the 'pancake effect' - affecting many buildings in Kathmandu (Nepal 2015) and Haiti in 2010.

Hazard-resistant design can include cross bracing to prevent floor collapse, steel reinforced walls to allow buildings to sway and a low centre of gravity to prevent buildings toppling over. Modern building codes require these aseismic design features to be incorporated in all new-builds in earthquake zones. The problem, as was apparent in the 2008 Sichuan earthquake, is that in some countries building codes are not consistently applied. In Sichuan, 7000 school buildings collapsed, even when neighbouring private buildings stood firm. Some of the most innovative hazard-resistant buildings include Los Angeles' Emergency Operations Centre (EOC) and San Francisco's Transamerica building. The EOC has flexible power and

gas cables, to prevent damage and is base-isolated, using friction pendulum technology to allow it to sway with seismic activity. The design should withstand a magnitude 8.0 earthquake. Older buildings, constructed before building codes were enforced, can be strengthened and given additional stabilisation through retro-engineering (retrofitting) – usually in the form of steel-skeleton girding support.

The layout of a city can determine the impacts of an earthquake. In Japan, lessons were learnt from the 1923 Tokyo earthquake and changes were implemented in all cities located in earthquake zones. Firebreaks in the form of public open spaces were included across cities, hospitals and emergency services were relocated in accessible places and highways were widened to allow access to the city during disasters.

Japan has effective planning (emergency evacuation plans, information management and warning systems) in place for earthquakes and tsunami. If foreshocks are felt the public are quickly warned through the media. September 1st is the anniversary of the Great Kanto Earthquake that struck Tokyo in 1923. It is also Disaster Prevention Day when disaster preparations, including earthquake drills take place across the country.

Impacts and human responses of the Haiti earthquake 2010
Haiti is located on the conservative plate margin between the North American plate and the Caribbean plate. On 12 January 2010 a powerful 7.0 magnitude earthquake struck Haiti. The epicentre was close to the capital Port-au-Prince and the shallow-focused earthquake devastated the capital city.

Impacts

- Over 220 000 people died.
- Over 180 000 homes were destroyed.
- Around two million people were left homeless; many still living in temporary shelters six years after the event.
- Education has been affected as 5000 schools were damaged or destroyed.
- The shaking destroyed services such as water, electricity and sanitation - already in a poor state.

Responses

- Haiti was unprepared for this disaster as it lacked a stable government. It required assistance from other countries to deal with the aftermath.
- The UN sent peacekeepers, who accidently introduced cholera to the water supplies, killing a further 9200 people.
- There was a lack of doctors and medical care for those who were injured in the earthquake.
- There was a global humanitarian response to Haiti, due to news-coverage. The UK's Disasters Emergency Committee (DEC) raised over £100m.
- The rebuild has been slow as most people survive on less than two dollars a day and cannot afford to rebuild their own homes.
- Many thousands of people have moved away from Port-au-Prince, hoping for a better life away from the capital city.

